L Number	Hits	Search Text	DB	Time stamp
1	3	(("6545287") or ("20030073295") or ("20030001242")).PN.	USPAT; US-PGPUB	2003/11/11 16:15
2	2	(("6143663") or ("6093631")).PN.	USPAT; US-PGPUB	2003/11/11 16:16
3	1	("6232231").PN.	USPAT; US-PGPUB	2003/11/11 16:30
4	30030	cmp or(chemical adj mechanical adj (polish or polishing))	USPAT; US-PGPUB	2003/11/11 16:31
5	468	(cmp or(chemical adj mechanical adj (polish or polishing))) and (free with (abrasive or particulate))	USPAT; US-PGPUB	2003/11/11 16:31
6	416	((cmp or(chemical adj mechanical adj (polish or polishing))) and (free with (abrasive or particulate))) and (conductive or conductor or metal or conducting)	USPAT; US-PGPUB	2003/11/11 16:32
7	54	(((cmp or(chemical adj mechanical adj (polish or polishing))) and (free with (abrasive or particulate))) and (conductive or conductor or metal or conducting)) and @ad<19980831	USPAT; US-PGPUB	2003/11/11 16:32

US-PAT-NO: 5972792

DOCUMENT-IDENTIFIER: US 5972792 A

TITLE: Method for chemical-mechanical planarization of a substrate on a fixed-abrasive polishing pad

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Abstract Text - ABTX (1):

A method for chemical-mechanical planarization of a substrate on a fixed-abrasive polishing pad in which a planarizing solution is dispensed onto the fixed-abrasive polishing pad. The planarizing solution is preferably an **abrasive-free** planarizing solution that oxidizes a surface layer on the substrate without passing the surface layer into solution, and the fixed-**abrasive** pad has a substantially uniform distribution of **abrasive** particles fixedly bonded to a suspension medium. The surface layer of the substrate is then pressed against the fixed-abrasive pad in the presence of planarizing solution, and at least one of the fixed-abrasive pad or the substrate moves relative to the other to remove material from the surface of the substrate. In operation, the planarizing solution forms a rough, scabrous layer of non-soluble oxides on the surface layer that are readily removed by the abrasive surface of the polishing pad. In one embodiment of the invention, the pH of the planarizing solution is controlled to oxidize the material of the surface layer without passing it into solution.

Brief Summary Text - BSTX (12):

The inventive CMP process preferably increases the polishing rate and reduces defects in fixed-abrasive pad CMP. In an embodiment of the invention for planarizing a metal surface layer on a substrate, an **abrasive-free** planarizing solution is dispensed onto a fixed-**abrasive** polishing pad. The **abrasive-free** planarizing solution preferably has an oxidant that oxidizes the metal on the surface of the substrate without passing the metal into solution. The fixed-abrasive pad has a suspension medium and a substantially uniform distribution of abrasive particles fixedly bonded to the suspension medium. The surface layer of the substrate is then pressed against the fixed-abrasive pad in the presence of the planarizing solution, and at least one of the fixed-abrasive pad or the substrate moves relative to the other. In operation, the planarizing solution forms a rough, scabrous layer of non-soluble oxides on the surface layer that is removed by the abrasive particles of the polishing pad. The non-soluble oxides are generally easier to detach from the substrate with mechanical force than the non-oxidized material.

Brief Summary Text - BSTX (14):

The inventive CMP process may be used to form electrically isolated conductive features on a semiconductor wafer by depositing an upper layer of conductive material onto a top surface of an insulating layer and into depressions in the insulating layer. A portion of the upper conductive layer is removed with the inventive CMP process until the insulating layer is exposed between the depressions in the insulating layer. More specifically, the upper conductive layer is preferably removed by dispensing an **abrasive-free,** oxidizing planarizing solution onto a fixed-**abrasive** pad; pressing the upper

conductive layer against the fixed-**abrasive** pad in the presence of the planarizing solution; and moving the upper conductive layer and the fixed-**abrasive** pad relative to each other. The remaining portions of the upper conductive layer in the depressions of the insulating layer form electrically isolated conductive features.

Detailed Description Text - DETX (2):

The present invention is a method for quickly planarizing a surface layer on a semiconductor wafer or other substrate with a fixed-abrasive polishing pad. An important aspect of an embodiment of the invention is to planarize the surface layer on a fixed-**abrasive** polishing pad covered with an **abrasive-free** planarizing solution that oxidizes and/or roughens the material of the surface layer without dissolving the material of the surface layer. The thin, roughened layer on the wafer is readily removed by the abrasive particles in the fixed-abrasive polishing pad, which increases the polishing rate of fixed-abrasive pad CMP. The method of the invention, therefore, increases the throughput of CMP processes using fixed-abrasive pads.

Detailed Description Text - DETX (7):

The present invention is particularly useful for planarizing metal layers from the front face 14 of the wafer 12 to form conductive features such as damascene lines and interlayer plugs. To planarize a conductive layer of tungsten from the wafer 12, the planarizing solution preferably has a pH below 5.0 and contains at least one of the following oxidants: ferric nitrate, hydrogen peroxide, potassium iodate, and bromine. In a specific example, a layer of tungsten may be quickly planarized with a silica-ceria fixed-**abrasive**

polishing pad and a particle-**free** potassium iodate planarizing solution at a pH of 4.5. One suitable planarizing solution is a modified QCTT1011-14B potassium iodate planarizing solution manufactured by Rodel Corporation of Newark, Del. The QCTT1011-14B solution is a conventional slurry with abrasive particles that has been used only on conventional, non-abrasive polishing pads. To modify the QCTT1101-14B solution for use in the present invention, the **abrasive** particles are removed to form an **abrasive-free** solution and the solution is used on a fixed-**abrasive** pad.

Detailed Description Text - DETX (14):

One advantage of the preferred embodiment of the present invention is that it enhances the throughput of wafers planarized with fixed-abrasive polishing pads without sacrificing the planarity of the wafers. Unlike slurries that dissolve the material of the surface layer, the present invention uses an **abrasive-free** planarizing solution that oxidizes the material of the surface layer without passing it into solution. As discussed above, the abrasive particles in the fixed-abrasive polishing pad remove scabrous, oxidized material faster than non-oxidized material. Additionally, because the planarizing solution merely oxidizes the material of the surface layer without passing it into solution, the top surface of conductive features are not etched below the top surface of an insulating layer. Therefore, the method of the invention increases throughput and produces highly planar surfaces.

Detailed Description Text - DETX (18):

From the foregoing it will be appreciated that, although specific embodiments of the invention have been described herein for